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Lee

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(54) **VOICE COIL MOTOR**

(56) **References Cited**

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U.S. PATENT DOCUMENTS

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7,400,463 B1 7/2008 Wu
7,486,882 B2 2/2009 Okita et al.

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(Continued)

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FOREIGN PATENT DOCUMENTS

CN 1952719 A 4/2007
CN 101068091 A 11/2007

(Continued)

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OTHER PUBLICATIONS

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Primary Examiner — Leda T Pham

(63) Continuation of application No. 16/993,799, filed on Aug. 14, 2020, now Pat. No. 11,489,430, which is a (Continued)

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(57) **ABSTRACT**

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(Continued)

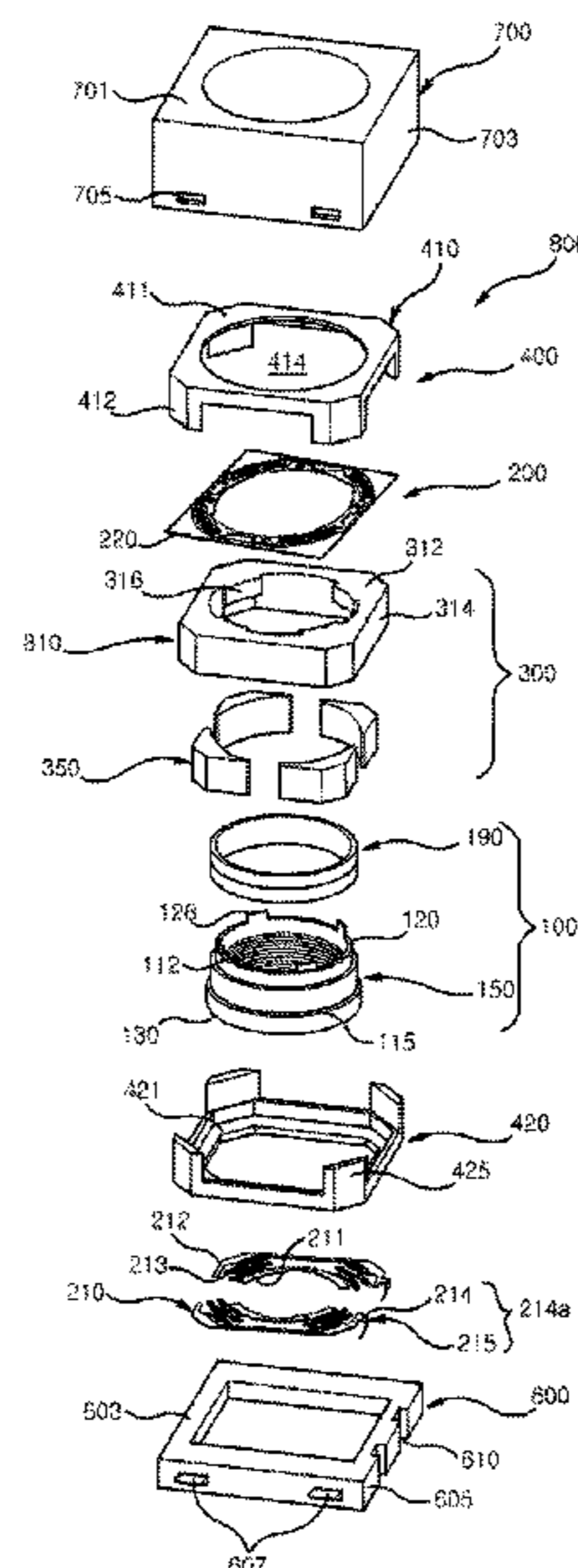
(52) **U.S. Cl.**
CPC *H02K 41/0356* (2013.01); *G03B 3/10* (2013.01); *H02K 33/04* (2013.01)

(58) **Field of Classification Search**
CPC H02K 41/0356; H02K 33/04; H02K 41/03; H02K 5/04; H02K 41/035; G03B 3/10; H04N 5/2252; G02B 7/023

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Disclosed is a voice coil motor, the motor including a mover having a bobbin equipped with a lens and a coil block secured to an outer circumference of the bobbin; a stator having a magnet that is disposed in such a way as to face the coil block; elastic members coupled to a lower end of the bobbin and connected to both ends of the coil block; a base supporting the elastic members and the stator; and a cover can covering the mover, the stator and the base, with an opening being formed in the cover can to expose the lens therethrough, wherein each of the elastic members includes a terminal portion that extends between the cover can and a side surface of the base, the terminal portion including a short-circuit prevention portion so as to inhibit a short-circuit between the terminal portion and the cover can.

20 Claims, 9 Drawing Sheets



Related U.S. Application Data

continuation of application No. 16/547,096, filed on Aug. 21, 2019, now Pat. No. 10,778,078, which is a continuation of application No. 16/164,091, filed on Oct. 18, 2018, now Pat. No. 10,432,077, which is a continuation of application No. 15/630,721, filed on Jun. 22, 2017, now Pat. No. 10,135,325, which is a continuation of application No. 15/214,018, filed on Jul. 19, 2016, now Pat. No. 9,722,481, which is a continuation of application No. 14/026,835, filed on Sep. 13, 2013, now Pat. No. 9,431,885, which is a continuation of application No. 13/184,866, filed on Jul. 18, 2011, now Pat. No. 8,558,419.

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- (58) **Field of Classification Search**
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 See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

7,576,455	B2	8/2009	Ho et al.
7,715,131	B2	5/2010	Chou et al.
7,824,115	B2	11/2010	Shih et al.
7,936,523	B2	5/2011	Higuchi
8,068,295	B2	11/2011	Park et al.
8,247,931	B2	8/2012	Liao
8,283,814	B2	10/2012	Liao
8,295,695	B2	10/2012	Yoshida et al.
8,498,069	B2*	7/2013	Ku F16F 1/027 359/811
9,804,354	B2*	10/2017	Kasuga H02K 41/0356
2006/0181632	A1	8/2006	Makii et al.
2006/0181748	A1	8/2006	Makii et al.
2007/0086770	A1	4/2007	Okita et al.
2008/0117536	A1	5/2008	Higuchi
2008/0212959	A1	9/2008	Shin et al.
2010/0061000	A1	3/2010	Higuchi
2010/0270870	A1	10/2010	Liao
2011/0044679	A1	2/2011	Yoshida et al.
2012/0057252	A1	3/2012	Ishiguro et al.

FOREIGN PATENT DOCUMENTS

CN	101178470	A	5/2008
CN	101546949	A	9/2009
JP	2006-081387	A	3/2006
JP	2010-066286	A	3/2010
JP	4919422	B2	2/2012
KR	10-2007-0042080	A	4/2007
KR	10-2007-0111171	A	11/2007

OTHER PUBLICATIONS

Office Action dated Aug. 10, 2016 in Korean Application No. 10-2010-0069652.
 Office Action dated Dec. 18, 2014 in Chinese Application No. 201110201818.6.
 Office Action dated Dec. 7, 2016 in Chinese Application No. 10521508120.
 Office Action dated Jan. 14, 2013 in U.S. Appl. No. 13/184,866.
 Office Action dated Nov. 7, 2016 in U.S. Appl. No. 15/214,018.
 Office Action dated Sep. 5, 2014 in U.S. Appl. No. 14/026,835.
 Office Action dated Feb. 8, 2019 in Korean Application No. 10-2019-0001949.
 Notice of Allowance dated Jun. 17, 2013 in U.S. Appl. No. 13/184,866.
 Office Action dated Feb. 10, 2014 in U.S. Appl. No. 14/026,835.
 Office Action dated Nov. 9, 2015 in U.S. Appl. No. 14/026,835.
 Notice of Allowance dated Apr. 20, 2016 in U.S. Appl. No. 14/026,835.
 Notice of Allowance dated Mar. 22, 2017 in U.S. Appl. No. 15/214,018.
 Office Action dated Jan. 3, 2018 in U.S. Appl. No. 15/630,721.
 Notice of Allowance dated Jul. 17, 2018 in U.S. Appl. No. 15/630,721.
 Office Action dated Nov. 30, 2018 in U.S. Appl. No. 16/164,091.
 Notice of Allowance dated May 21, 2019 in U.S. Appl. No. 16/164,091.
 Office Action dated Nov. 4, 2019 in U.S. Appl. No. 16/547,096.
 Notice of Allowance dated May 14, 2020 in U.S. Appl. No. 16/547,096.
 Office Action dated Jan. 4, 2021 in Korean Application No. 10-2020-0146252.
 Office Action dated Dec. 9, 2021 in U.S. Appl. No. 16/993,799.
 Office Action dated Apr. 1, 2022 in U.S. Appl. No. 16/993,799.
 Notice of Allowance dated Jun. 8, 2022 in U.S. Appl. No. 16/993,799.

* cited by examiner

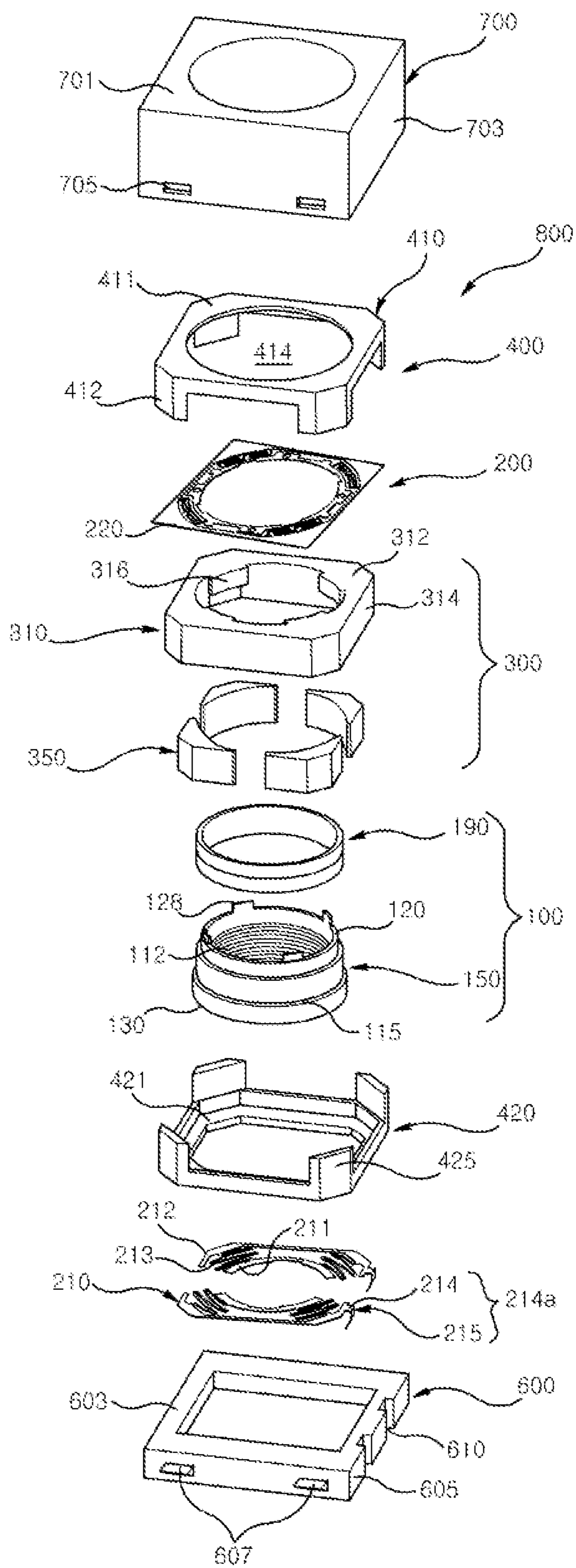


FIG. 1

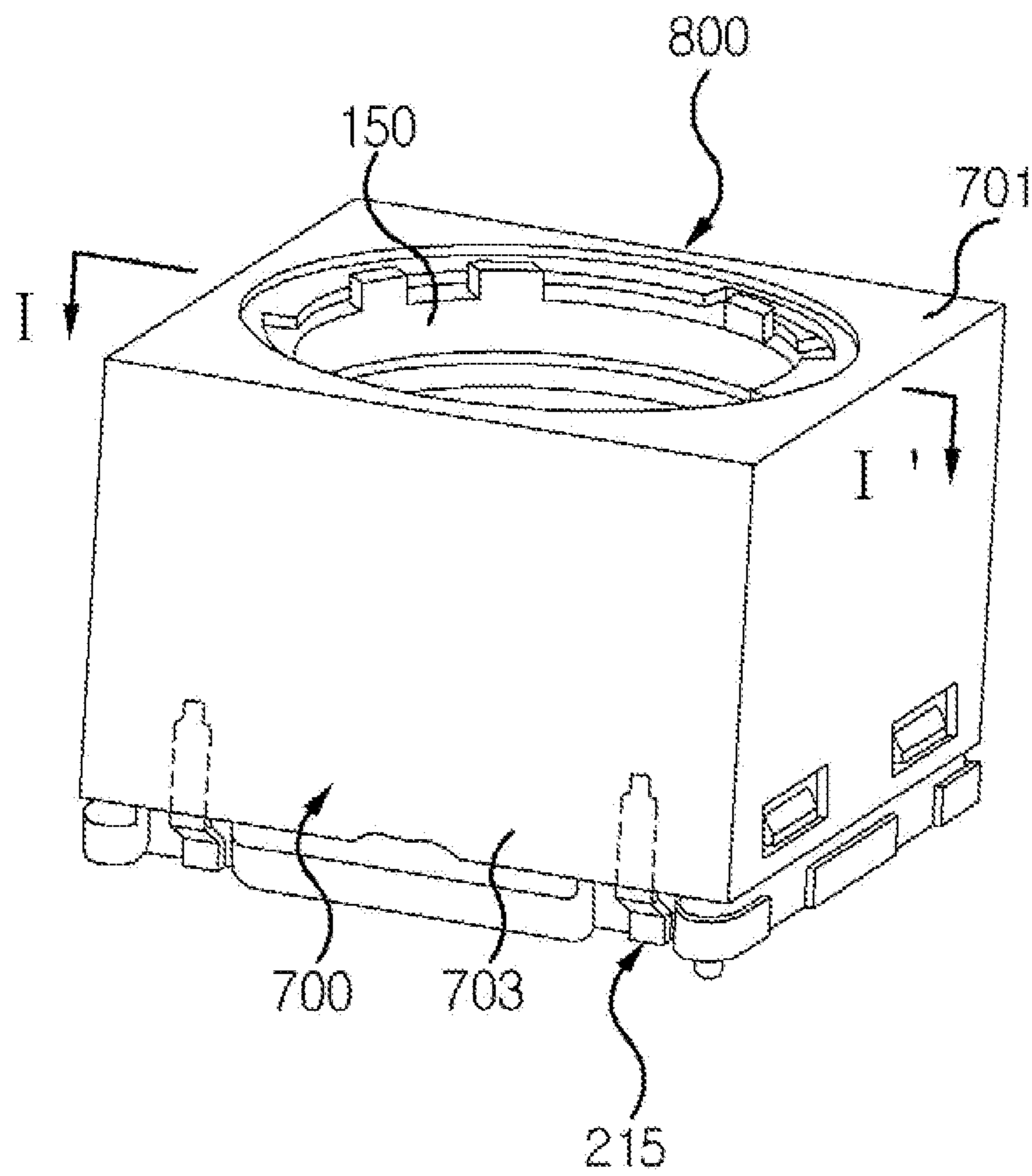


FIG. 2

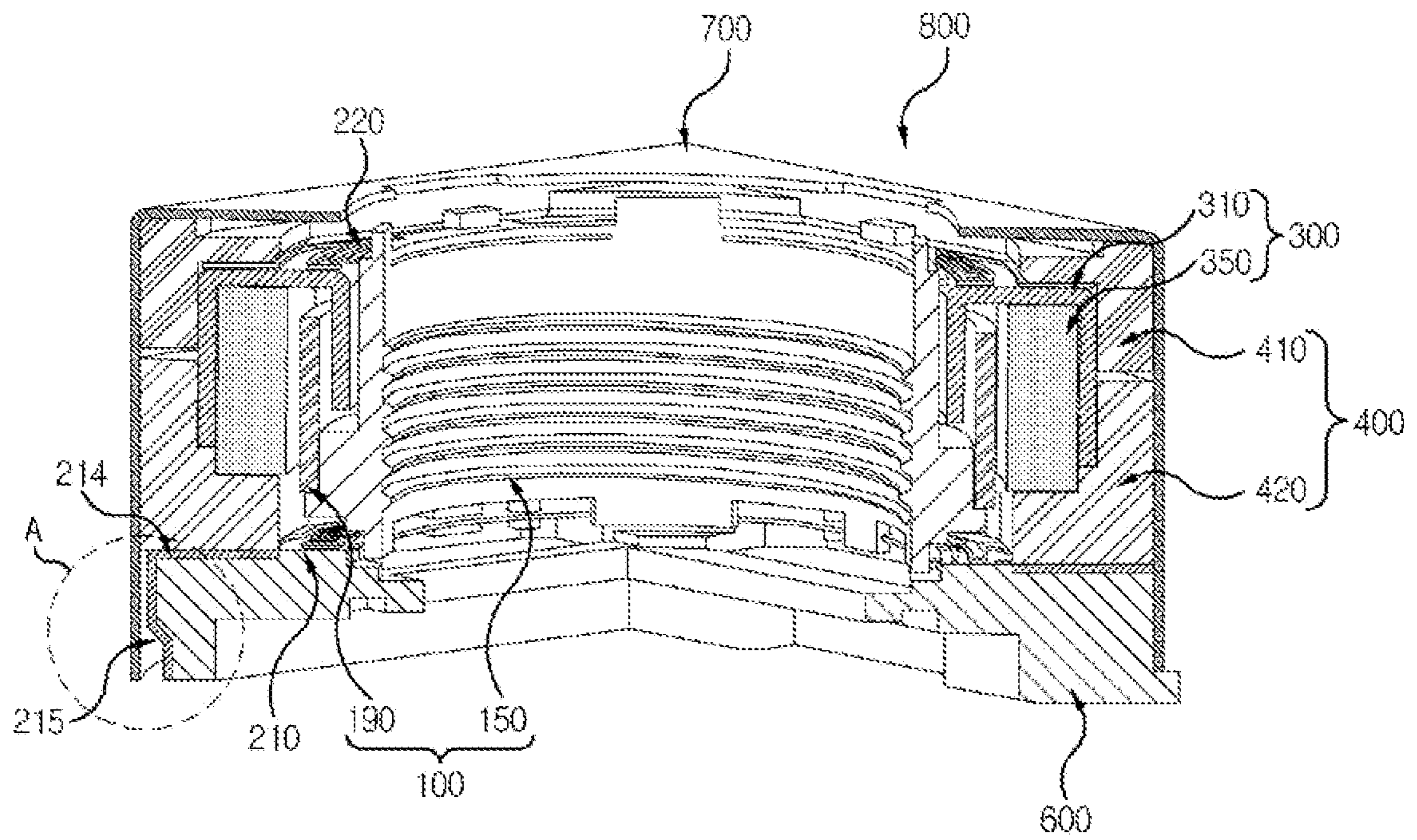


FIG. 3

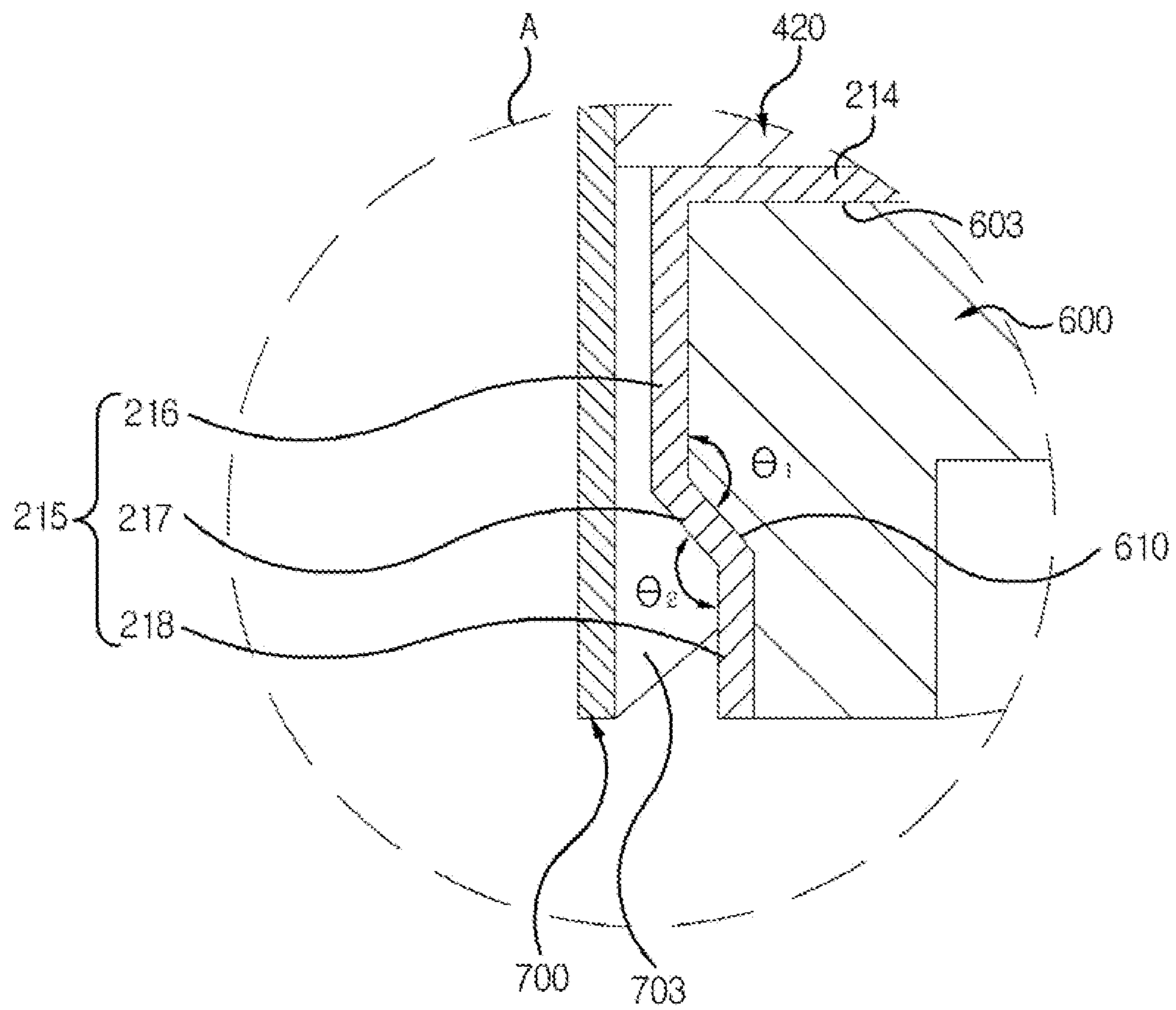


FIG. 4

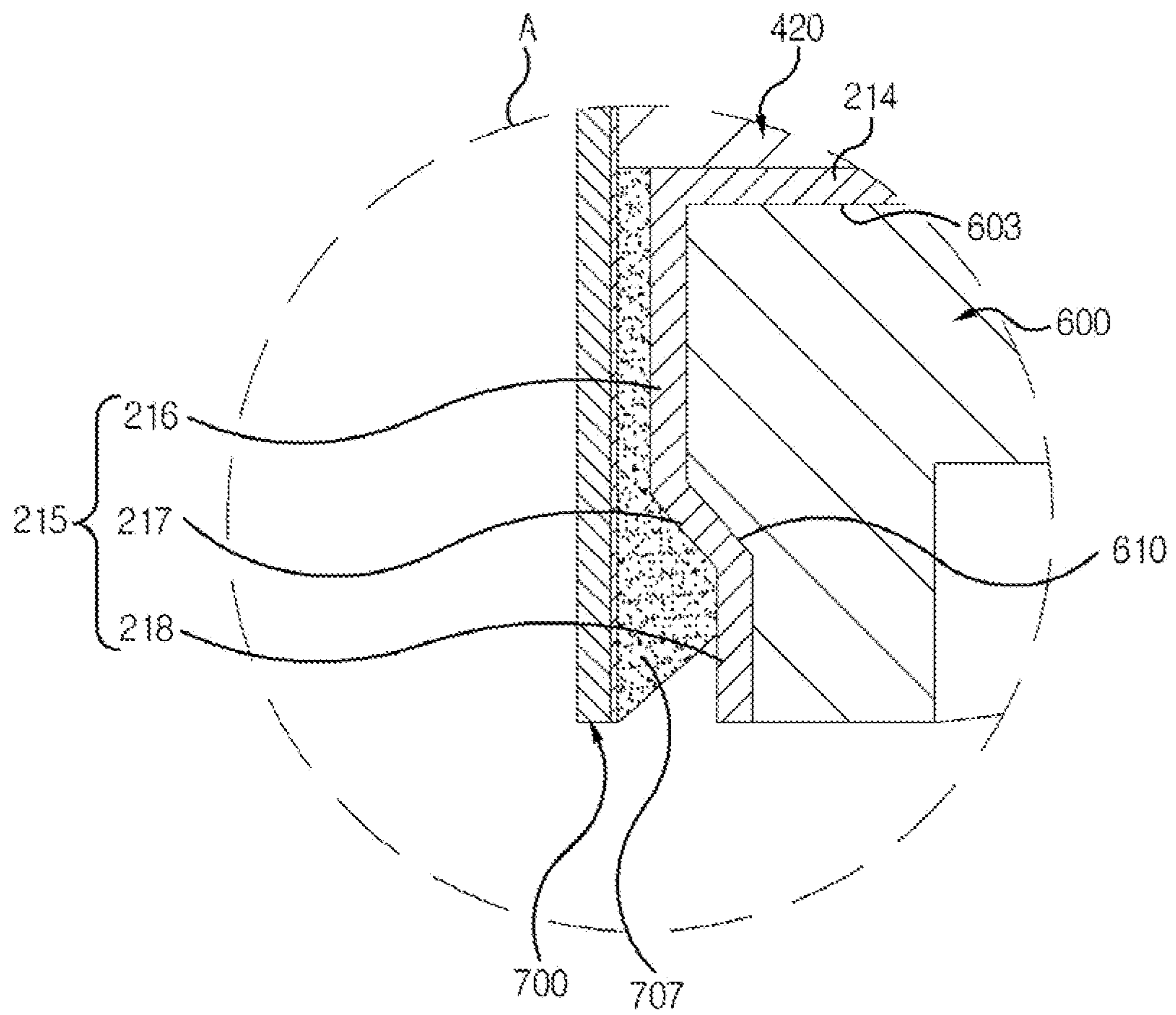


FIG. 5

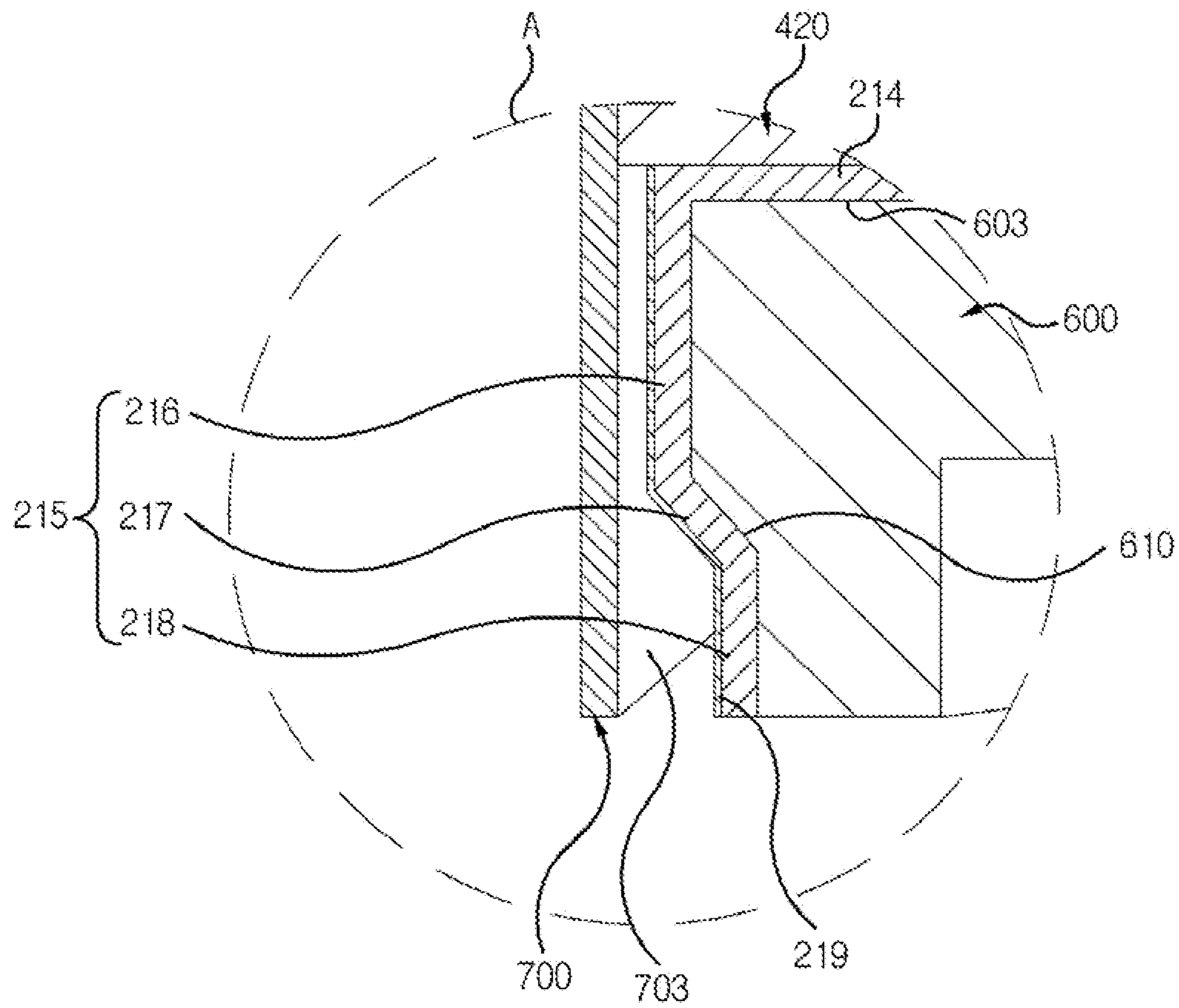


FIG. 6

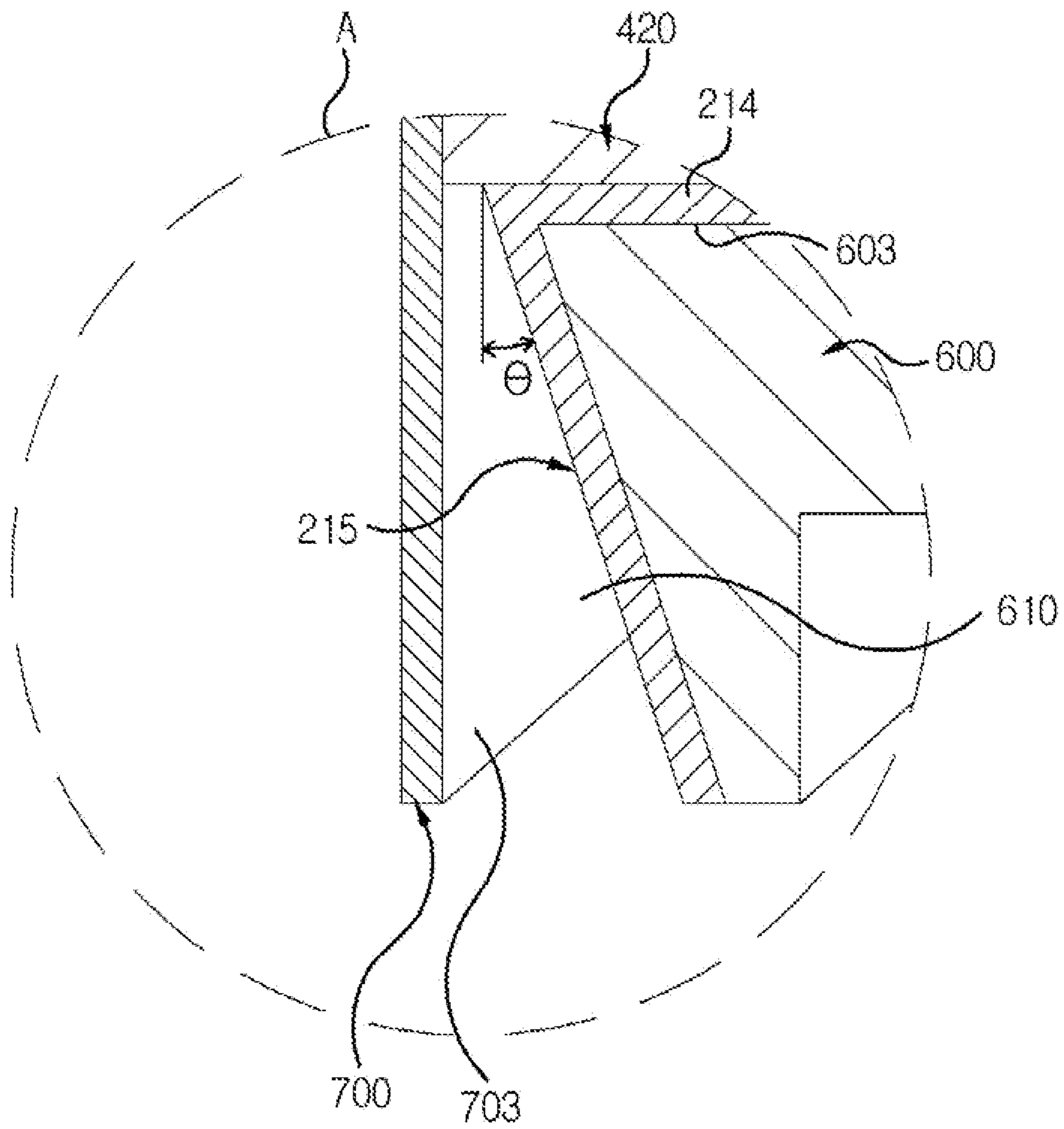


FIG. 7

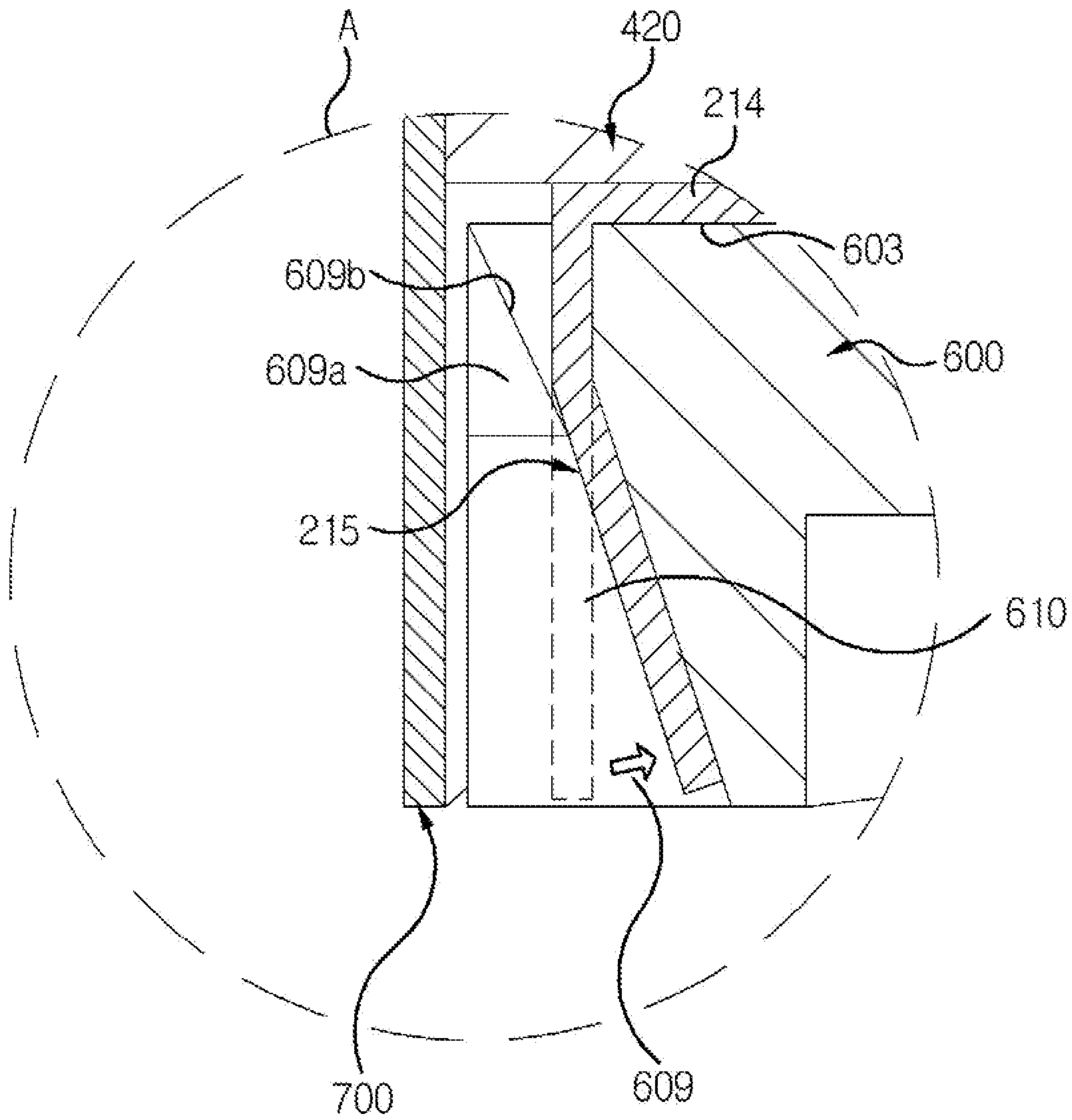


FIG. 8

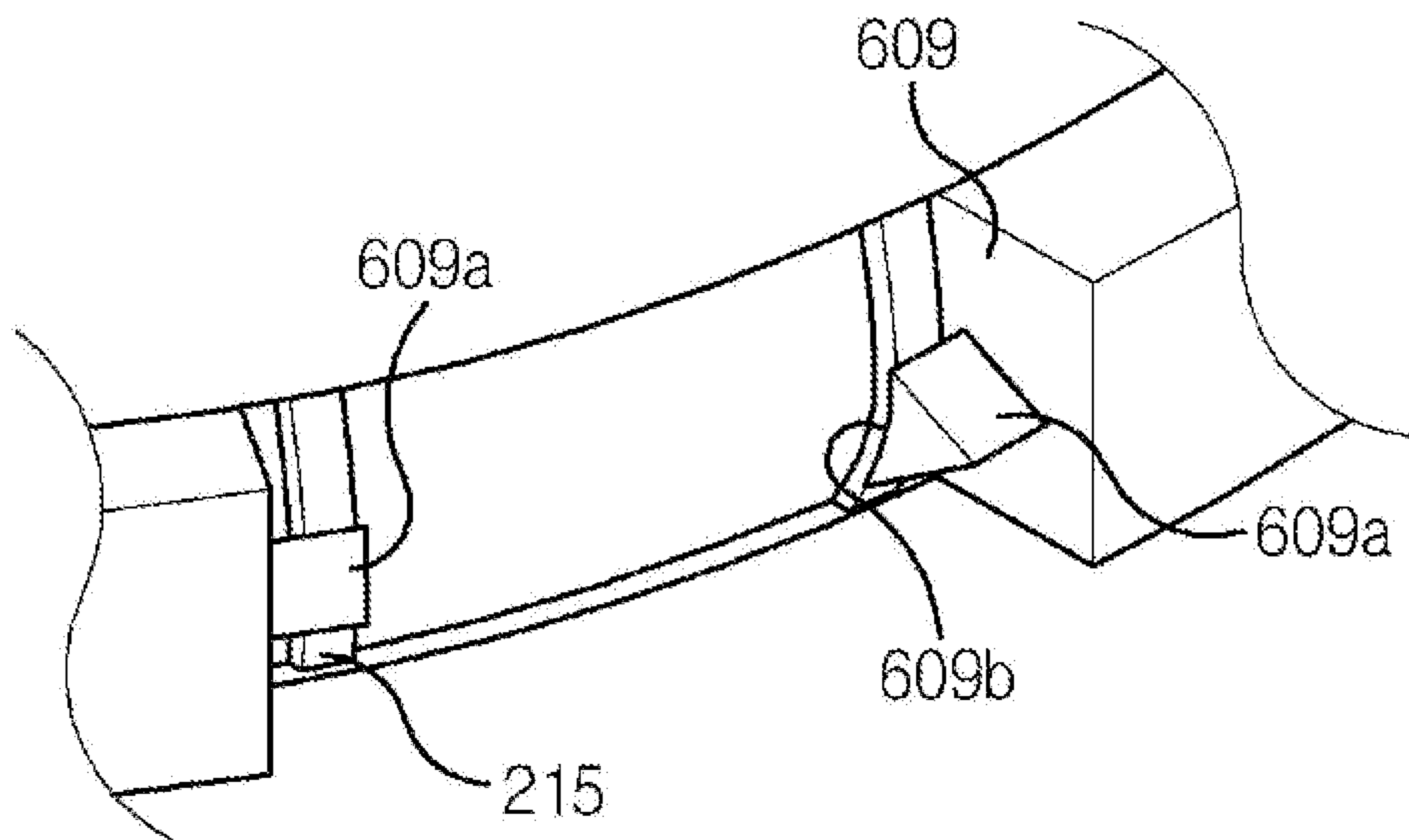


FIG. 9

VOICE COIL MOTORCROSS-REFERENCE TO RELATED
APPLICATIONS

This application is a continuation of U.S. application Ser. No. 16/993,799, filed Aug. 14, 2020; which is a continuation of U.S. application Ser. No. 16/547,096, filed Aug. 21, 2019, now U.S. Pat. No. 10,778,078, issued Sep. 15, 2020; which is a continuation of U.S. application Ser. No. 16/164,091, filed Oct. 18, 2018, now U.S. Pat. No. 10,432,077, issued Oct. 1, 2019; which is a continuation of U.S. application Ser. No. 15/630,721, filed Jun. 22, 2017, now U.S. Pat. No. 10,135,325, issued Nov. 20, 2018; which is a continuation of U.S. application Ser. No. 15/214,018, filed Jul. 19, 2016, now U.S. Pat. No. 9,722,481, issued Aug. 1, 2017; which is a continuation of U.S. application Ser. No. 14/026,835, filed Sep. 13, 2013, now U.S. Pat. No. 9,431,885, issued Aug. 30, 2016; which is a continuation of U.S. application Ser. No. 13/184,866, filed Jul. 18, 2011, now U.S. Pat. No. 8,558,419, issued Oct. 15, 2013; which claims the benefit under 35 U.S.C. § 119 of Korean Patent Application No. 10-2010-0069652, filed Jul. 19, 2010, all of which are hereby incorporated by reference in their entirety.

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to a voice coil motor.

Description of the Related Art

Recently, a variety of optical devices, such as a mobile phone equipped with a micro digital camera, have been developed.

As for the micro digital camera applied to the conventional mobile phone, it is impossible to adjust an interval between a lens used to concentrate external light and an image sensor used to convert the external light into an image. However, recently, the interval between the image sensor and the lens can be adjusted by a lens driving device such as a voice coil motor, so that the mobile phone can obtain a more improved image.

A conventional voice coil motor includes a mover, a stator, an elastic member, and a cover can. The mover includes a coil block that produces a magnetic field to drive a lens up and down. The stator faces the mover, and produces a magnetic field to drive the mover. The elastic member elastically supports the mover that moves up and down. The cover can covers the mover, the stator and the elastic member.

Meanwhile, in order to produce the magnetic field from the coil block, the coil block is electrically connected to the elastic member, and the elastic member is electrically connected to an external circuit board.

In recent years, in order to block harmful electromagnetic waves produced from the voice coil motor, the cover can covers surfaces of the voice coil motor other than a bottom surface thereof. Such a construction causes a portion of the elastic member for connecting the elastic member to the external circuit board and the cover can to be short-circuited, so that the malfunction of the voice coil motor frequently occurs.

BRIEF SUMMARY

Accordingly, the present invention provides a voice coil motor, which is intended to inhibit a cover can for blocking

harmful electromagnetic waves and a portion of an elastic member supplying power to a coil block from being electrically short-circuited, thus inhibiting the malfunction of the voice coil motor.

In one general aspect of the present invention, there is provided a voice coil motor, the motor comprising: a mover including a bobbin equipped with a lens and a coil block secured to an outer circumference of the bobbin; a stator including a magnet that is disposed in such a way as to face the coil block; elastic members coupled to a lower end of the bobbin and connected to both ends of the coil block; a base supporting the elastic members and the stator; and a cover can covering the mover, the stator and the base, with an opening being formed in the cover can to expose the lens therethrough, wherein each of the elastic members comprises a terminal portion that extends between the cover can and a side surface of the base, the terminal portion including a short-circuit prevention portion so as to inhibit a short-circuit between the terminal portion and the cover can.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an exploded perspective view showing a voice coil motor in accordance with an exemplary embodiment of the present invention;

FIG. 2 is a perspective view showing an external appearance of the voice coil motor of FIG. 1;

FIG. 3 is a sectional view taken along line I-I' of FIG. 2;

FIG. 4 is an enlarged view showing portion 'A' of FIG. 3;

FIG. 5 is a sectional perspective view showing a short-circuit prevention portion of a voice coil motor in accordance with another exemplary embodiment of the present invention;

FIG. 6 is a sectional perspective view showing a short-circuit prevention portion of a voice coil motor in accordance with a further exemplary embodiment of the present invention;

FIG. 7 is a sectional perspective view showing a short-circuit prevention portion of a voice coil motor in accordance with another exemplary embodiment of the present invention;

FIG. 8 is a sectional perspective view showing a short-circuit prevention portion and a guide portion of a voice coil motor in accordance with another exemplary embodiment of the present invention; and

FIG. 9 is a perspective view showing the guide portion and the short-circuit prevention portion of FIG. 8.

DETAILED DESCRIPTION

Hereinafter, exemplary embodiments of the present invention will be described in detail with reference to the accompanying drawings. For clarity and convenience of description, the size or shape of components shown in the drawings may not be illustrated to scale. Further, terminologies defined in consideration of the construction and effect of the present invention may be changed according to a user or operator intention or the custom. These terminologies should be interpreted as having meanings and concepts in keeping with the technical spirit of the present invention based on the overall detailed description.

FIG. 1 is an exploded perspective view showing a voice coil motor in accordance with an exemplary embodiment of the present invention. FIG. 2 is a perspective view showing an external appearance of the voice coil motor of FIG. 1. FIG. 3 is a sectional view taken along line I-I' of FIG. 2. FIG. 4 is an enlarged view showing portion 'A' of FIG. 3.

Referring to FIGS. 1 to 4, a voice coil motor **800** includes a mover **100**, an elastic member **200**, a stator **300**, a casing **400**, a base **600** and a cover can **700**.

The mover **100** includes a bobbin **150** and a coil block **190**. The bobbin **150** is movable in the optical axis direction (i.e., the vertical direction as depicted in FIGS. 1 to 4).

The bobbin **150** is formed, for example, to have the shape of a cylinder that has a hole for receiving a lens therein. The cylindrical bobbin **150** includes an upper surface **120** and a lower surface **130** that is opposite to the upper surface **120**.

An internal threaded portion **112** is formed on an inner circumference of the bobbin **150** to receive the lens, and a lens holding member (not shown) is fastened to the internal threaded portion **112**. The lens is coupled to the lens holding member. Unlike this construction, the lens may be directly fastened to the internal threaded portion **112** of the bobbin **150**.

A step **115** is provided on a lower portion of an outer circumference of the bobbin **150** to support the coil block **190** that will be described below in detail.

Projection-shaped bosses are provided on the lower surface **130** of the bobbin **150**, so that first elastic members **210** of the elastic member **200**, which will be described below in detail, are coupled to the bobbin **150** using the bosses.

The coil block **190** of the mover **100** is placed on the step **115** which is formed on the bobbin **150**. The coil block **190** is formed, for example, by winding a coil into a cylindrical shape.

The coil block **190** is directly wound around the outer circumference of the bobbin **150**. Alternatively, after the coil is wound in a cylindrical shape, this may be attached to the outer circumference of the bobbin **150** by an adhesive or the like.

The elastic member **200** includes the first elastic members **210** and a second elastic member **220**. In the embodiment of the present invention, the first and second elastic members **210** and **220** may comprise plate springs.

The first elastic members **210** are coupled to the lower surface **130** of the bobbin **150**. For example, the first elastic members **210** may comprise two elastic members. The first elastic members **210** are coupled, respectively, to the bosses of the lower surface **130** of the bobbin **150**.

Each of the two first elastic members **210** includes an inner portion **211**, an outer portion **212** and a coupling portion **213**.

The inner portion **211** is coupled to the corresponding boss that is provided on the lower surface **130** of the bobbin **150**, the outer portion **212** is secured between the base **600** that will be described below in detail and a lower casing **420** of the casing **400**, and the coupling portion **213** couples the inner portion **211** with the outer portion **212**.

The second elastic member **220** is coupled to the upper surface **120** of the bobbin **150**.

The stator **300** includes a yoke **310** and magnets **350**.

The yoke **310** includes a top plate **312**, side plates **314** and a yoke portion **316**.

When viewed on a plane, the top plate **312** of the yoke **310** may be formed to have the shape of a rectangular plate, with a circular opening being formed in a central portion of the top plate **312** to expose an upper end of the bobbin **150**.

The side plates **314** extend from four edges of the top plate **312** in such a way as to be parallel to the outer circumference of the bobbin **150**. The side plates **314** are formed integrally with the four edges of the top plate **312**.

The yoke portion **316** protrudes from an inner surface of the top plate **312**, which is defined by the circular opening of the top plate **312**, toward the lower end of the bobbin **150**.

The yoke portion **316** is located at a position in such a way as to be inserted into a space defined between the bobbin **150** and the coil block **190**.

The magnets **350** are disposed in space defined by the top plate **312** and the side plates **314** of the yoke **310**. The respective magnets **350** are placed in such a way as to face the coil block **190**.

Force generated by interaction between a magnetic field produced from the magnets **350** and a magnetic field produced from the coil block **190** may move the bobbin **150** up. The bobbin **150** is elastically supported by the first and second elastic members **210** and **220**. Here, by precisely adjusting current applied to the coil block **190**, a moving distance of the bobbin **150** can be precisely adjusted.

The casing **400** includes an upper casing (or upper spacer) **410** and a lower casing (or lower spacer) **420**.

The upper casing **410** includes a top plate **411** and coupling pillars **412**. The upper casing **410** is placed on an upper portion of the yoke **310**, and the second elastic member **220** of the elastic member **200** is interposed between the upper casing **410** and the yoke **310**.

When viewed on a plane, the top plate **411** of the upper casing **410** may be formed to have the shape of a rectangular plate. An opening **414** is formed in a central portion of the top plate **411** of the upper casing **410** to expose the bobbin **150** through the opening **414**.

The coupling pillars **412** of the upper casing **410** protrude from four corners of the top plate **411** in such a way as to be parallel to the bobbin **150**. The coupling pillars **412** are coupled to the lower casing **420** that will be described below in detail.

The lower casing **420** includes pillars **425** that are coupled, respectively, with the coupling pillars **412** of the upper casing **410**.

The base **600** functions to support the first elastic member **210** of the elastic member **200** that elastically supports the stator **300** and the mover **100**. Further, an IR filter and/or an image sensor unit (not shown) may be mounted on the base **600**.

The base **600** may be shaped, for example, like a plate of a rectangular parallelepiped, and an opening **601** is formed in a central portion of the base **600** in such a way as to correspond to the lens mounted to the bobbin **150**.

The base **600** shaped like the rectangular parallelepiped plate includes an upper surface **603** and side surfaces **605** connected to the upper surface **603**. Among the side surfaces **605** of the base **600**, facing side surfaces have hooks **607**.

Further, one pair of receiving recesses **610** is formed concavely in a side surface **605** of the base **600** on which no hook **607** is formed. Each receiving recess **610** is formed at a position corresponding to a short-circuit prevention portion that is provided on each first elastic member **210** of the elastic member **200**, which will be described later.

In an embodiment of the present invention, each receiving recess **610** may be formed in the side surface **605** of the base **600** such that a depth of the recess **610** is gradually increased or variable in a direction from the upper surface of the base **600** to a lower surface that is opposite to the upper surface. Unlike this, the receiving recess **610** may be formed such that its depth is constant. A short-circuit prevention portion **215** that will be described below in detail is in close contact with a bottom surface formed by the receiving recess **610**.

Meanwhile, a ground terminal may be provided on the upper surface **603** of the base **600** to ground the cover can **700** that will be described below in detail.

The cover can **700** is shaped like a hexahedral box that is open at a lower surface, and an opening is formed in a top

plate 701 of the cover can 700 to expose the lens mounted to the bobbin 150 through the opening.

Side plates 703 (which can also be referred to as lateral plates) are formed integrally on edges of the top plate 701 of the cover can 700, and hook insertion holes 705 are formed in the side plates 703 in such a way as to correspond to the hooks 607 of the base 600, so that the hooks 607 are inserted into the hook insertion holes 705.

For example, the cover can 700 converts harmful electromagnetic waves produced from an inside of the voice coil motor 800 into heat or current, thus inhibiting the harmful electromagnetic waves from being emitted to the outside of the voice coil motor 800. To this end, the cover can 700 is manufactured, for example, using a metal plate that is suitable for blocking electromagnetic waves.

Referring to FIGS. 3 and 4, the first elastic members 210 of the elastic member 200 are disposed on the base 600, and a terminal portion 214a is provided on the outer portion 212 of each first elastic member 210.

The terminal portion 214a includes a connection portion 214 and the short-circuit prevention portion 215. The connection portion 214 and the short-circuit prevention portion 215 of the terminal portion 214a provided on the first elastic member 210 apply a driving signal from an external board to the coil block 190 provided on the outer circumference of the bobbin 150. In an embodiment of the present invention, the short-circuit prevention portion 215 may protrude downwards from the base 600. Referring again to FIGS. 1 and 2, the terminal portion 214a can comprise a first portion (e.g., 216; which can also be referred to as a first area) overlapped with the side plate (or lateral plate) 703 of the cover can 700, and a second portion (e.g., 218; which can also be referred to as a second area) extending from the first portion, and overlapped with the base 600 in a direction perpendicular to an optical axis (i.e., laterally as depicted in the figures). The second portion of the terminal portion 214a can comprise a bent portion, and the side plate (or lateral plate) 703 of the cover can 700 can comprise an area not overlapped with at least a part of the bent portion in the direction perpendicular to the optical axis. The bent portion of the second portion of the terminal portion 214a can have an area opened from a part of the side plate (or lateral plate) 703 of the cover can 700. Also, the bent portion of the second portion of the terminal portion 214a can be electrically isolated from the cover can 700. Further, the bent portion can be overlapped with the base 600 in the direction perpendicular to an optical axis, and at least a part of the bent portion can be disposed such that it is not overlapped with a part of the cover can 700 in the direction perpendicular to the optical axis.

The connection portion 214 extends from an edge of the outer portion 212. The connection portion 214 is interposed between the upper surface 603 of the base 600 and the lower casing 420.

The short-circuit prevention portion 215 may include a first short-circuit prevention portion 216, a second short-circuit prevention portion 217, and a third short-circuit prevention portion 218.

The first short-circuit prevention portion 216 extends from the connection portion 214. The first short-circuit prevention portion 216 extends between the receiving recess 610 formed in the side surface of the base 600 and an inner surface of the side plate 703 of the cover can 700. The first short-circuit prevention portion 216 is formed, for example, to be perpendicular to the connection portion 214.

The second short-circuit prevention portion 217 extends from the first short-circuit prevention portion 216. The second short-circuit prevention portion 217 is bent from the

first short-circuit prevention portion 216, and forms an obtuse angle $\theta 1$ with the first short-circuit prevention portion 216.

The third short-circuit prevention portion 218 extends from the second short-circuit prevention portion 217, and is bent from the second short-circuit prevention portion 217 in such a way as to be parallel to the side plate 703 of the cover can 700. Thus, the second short-circuit prevention portion 217 and the third short-circuit prevention portion 218 form an obtuse angle $\theta 2$ therebetween. As seen in FIGS. 3 and 4, the terminal 215 can include an inclined portion with respect to the side plate 703 of the cover can 700, and the inclined portion can be the second short-circuit prevention portion 217 (see also FIGS. 5 and 6).

In an embodiment of the present invention, the receiving recess 610 formed in the base 600 to receive the short-circuit prevention portion 215 has shape corresponding to that of the first to third short-circuit prevention portions 216, 217 and 218. Thus, the first to third short-circuit prevention portions 216, 217 and 218 come into close contact with the bottom surface defined by the receiving recess 610 formed in the side surface 605 of the base 600.

Further, an adhesive may be interposed between the bottom surface defined by the receiving recess 610 and the first to third short-circuit prevention portions 216, 217 and 218 so as to inhibit the first to third short-circuit prevention portions 216, 217, and 218 from making contact with the cover can 700.

According to an embodiment of the present invention, the receiving recess 610 is formed in the base 600, and at least a portion of the short-circuit prevention portion 215 extending from each first elastic member 210 placed on the base 600 is inclined from the inner surface of the side plate 703 of the cover can 700, thus inhibiting the cover can 700 and the first elastic member 210 from being electrically short-circuited.

FIG. 5 is a sectional perspective view showing a short-circuit prevention portion of a voice coil motor in accordance with another exemplary embodiment of the present invention. The general construction of the voice coil motor shown in FIG. 5 remains the same as the voice coil motor shown in and described with reference to FIGS. 1 to 4, except form an insulation member. Therefore, the duplicated description of the same construction will be omitted, and the same component will carry the same reference numeral.

Referring to FIG. 5, even though the receiving recess 610 is formed in the base 600 and the short-circuit prevention portion 215 electrically connected to the first elastic member 210 is provided in the receiving recess 610, if external strong shock or vibration is applied to the voice coil motor, the short-circuit prevention portion 215 moves slightly, so that the inner surface of the side plate 703 of the cover can 700 and the short-circuit prevention portion 215 may come into contact with each other and thereby may be short-circuited.

In an embodiment of the present invention, an insulation layer 707 may be coated on the inner surface of the side plate 703 facing the short-circuit prevention portion 215 so as to inhibit the side plate 703 of the cover can 700 and the short-circuit prevention portion 215 from being short-circuited.

In an embodiment of the present invention, the insulation layer 707 may be formed throughout the overall area of the inner surface of the side plate 703 of the cover can 700 or formed locally on the inner surface of the side plate 703 corresponding to the short-circuit prevention portion 215.

FIG. 6 is a sectional perspective view showing a short-circuit prevention portion of a voice coil motor in accor-

dance with a further exemplary embodiment of the present invention. The general construction of the voice coil motor shown in FIG. 6 remains the same as the voice coil motor shown in and described with reference to FIGS. 1 to 4, except form an insulation member. Therefore, the duplicated description of the same construction will be omitted, and the same component will carry the same reference numeral.

Referring to FIG. 6, even though the receiving recess 610 is formed in the base 600 and the short-circuit prevention portion 215 electrically connected to the first elastic member 210 is provided in the receiving recess 610, if external strong shock or vibration is applied to the voice coil motor, the short-circuit prevention portion 215 moves slightly, so that the inner surface of the side plate 703 of the cover can 700 and the short-circuit prevention portion 215 may come into contact with each other and thereby may be short-circuited. In an embodiment of the present invention, an insulation layer 707 may be coated on a surface of the short-circuit prevention portion 215 facing the inner surface of the side plate 703 so as to inhibit the side plate 703 of the cover can 700 and the short-circuit prevention portion 215 from being short-circuited.

The insulation layer 219 may be formed throughout the overall area of the surface of the short-circuit prevention portion 215.

According to the embodiment of the present invention, the insulation layer is formed on either of the inner surface of the cover can 700 or the short-circuit prevention portion 215. However, without being limited to the embodiment, a first insulation member may be provided on the short-circuit prevention portion 215 facing the cover can 700, and a second insulation member may be provided on the inner surface of the cover can 700 facing the short-circuit prevention portion 215.

FIG. 7 is a sectional perspective view showing a short-circuit prevention portion of a voice coil motor in accordance with another exemplary embodiment of the present invention. The general construction of the voice coil motor shown in FIG. 7 remains the same as the voice coil motor shown in and described with reference to FIGS. 1 to 4, except form a short-circuit prevention portion. Therefore, the duplicated description of the same construction will be omitted, and the same component will carry the same reference numeral.

Referring to FIGS. 1 to 7, the short-circuit prevention portion 215, connected to the connection portion 214 extending from the outer portion 212 of the first elastic member 210, is shaped like a linear plate. The short-circuit prevention portion 215 shaped like the linear plate forms an acute angle θ with the inner surface of the side plate 703 of the cover can 700.

Further, among surfaces formed by the receiving recess 610 of the base 600 corresponding to the short-circuit prevention portion 215 which is not bent, the surface corresponding to the short-circuit prevention portion 215 is formed as a reverse inclined surface in such a way as to be in close contact with the short-circuit prevention portion 215.

FIG. 8 is a sectional perspective view showing a short-circuit prevention portion and a guide portion of a voice coil motor in accordance with another exemplary embodiment of the present invention. FIG. 9 is a perspective view showing the guide portion and the short-circuit prevention portion of FIG. 8. The general construction of the voice coil motor shown in FIGS. 8 and 9 remains the same as the voice coil motor shown in and described with reference to FIGS. 1 to 4, except form the guide portion. Therefore, the duplicated

description of the same construction will be omitted, and the same component will carry the same reference numeral.

Referring to FIGS. 8 and 9, the short-circuit prevention portion 215 is bent from the connection portion 214 electrically connected to the first elastic member 210. For example, the short-circuit prevention portion 215 is formed to be perpendicular to the connection portion 214.

Meanwhile, guide ribs 609a are provided, respectively, on opposite side walls 609 that are defined by the receiving recess 610 formed in the side surface 605 of the base 600. Each guide rib 609a guides the short-circuit prevention portion 215, which is disposed to be perpendicular to the connection portion 214, to allow the short-circuit prevention portion 215 to be inclined relative to the inner surface of the side plate 703 of the cover can 700 without an additional bending process.

To this end, each guide rib 609a includes an inclined surface 609b, and the inclined surface 609a is formed as a reverse inclined surface relative to the side surface 605 of the base 600, and the side surface 605 of the base 600 and the inclined surface 609b are, for example, formed at an acute angle.

In an embodiment of the present invention, the short-circuit prevention portion 215 is bent to be spaced apart from the side plate 703 of the cover can 700 using the guide rib 609a during assembly, thus inhibiting the first elastic member 210 and the cover can 700 from being electrically short-circuited.

Meanwhile, unlike the above-mentioned embodiment of the present invention, in order to inhibit the short-circuit prevention portion 215 and the cover can 700 from being short-circuited, a portion of the cover can 700 corresponding to the short-circuit prevention portion 215 may be cut and then an insulation plate may be provided in the cut portion of the cover can 700.

Further, unlike the above-mentioned embodiment of the present invention, in order to inhibit the short-circuit prevention portion 215 and the cover can 700 from being short-circuited, the inner surface of the cover can 700 corresponding to the short-circuit prevention portion 215 may protrude outwards. Such a construction can also inhibit the cover can 700 and the short-circuit prevention portion 215 from being short-circuited.

As described above, the present invention provides a voice coil motor, in which a cover can cover surfaces of the voice coil motor other than a bottom surface thereof so as to block harmful electromagnetic waves, and an elastic member is provided with a short-circuit prevention portion so as to inhibit the cover can and the elastic member placed on a base from being in electric contact with each other, so that operation characteristics of the voice coil motor can be more improved.

Although the preferred embodiments of the present invention have been disclosed for illustrative purposes, those skilled in the art will appreciate that various modifications, additions and substitutions are possible, without departing from the scope and spirit of the invention as disclosed in the accompanying claims.

The invention claimed is:

1. A voice coil motor, comprising:

- a base;
- a cover can disposed on the base and having a first lateral plate;
- a bobbin disposed in the cover can;
- a coil and a magnet disposed in the cover can;
- a first elastic member disposed between the bobbin and the base; and

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a terminal disposed on the base,
 wherein the terminal is electrically connected with the
 first elastic member,
 wherein the terminal comprises a first area overlapped
 with the first lateral plate of the cover can, a second area
 overlapped with the base in a direction perpendicular to
 an optical axis, and a bent area connected between the
 first area and second area,
 wherein at least a part of the bent area of the terminal is
 overlapped with a lateral surface of the base, and
 wherein the second area is not overlapped with the first
 lateral plate of the cover can in the direction perpen-
 dicular to the optical axis.

2. The voice coil motor of claim 1, wherein the base
 comprises a recess concavely formed on the lateral surface
 of the base, and

wherein the terminal is disposed on the recess of the base.

3. The voice coil motor of claim 1, wherein, in the
 direction perpendicular to the optical axis, one part of the
 bent area of the terminal is overlapped with the first lateral
 plate of the cover can and an other part of the bent area of
 the terminal is not overlapped with the first lateral plate of
 the cover can.

4. The voice coil motor of claim 1, wherein the bent area
 of the terminal comprises an area gradually away from the
 first lateral plate of the cover can.

5. The voice coil motor of claim 1, wherein, in the
 direction perpendicular to the optical axis, a distance
 between the first area of the terminal and an inner surface of
 the first lateral plate of the cover can is different from a
 distance between the second area of the terminal and an
 imaginary plane extending from the inner surface of the first
 lateral plate of the cover can.

6. The voice coil motor of claim 1, wherein the bent area
 of the terminal is from a bent point of the first area to a
 starting point of the second area disposed in a downward
 direction.

7. The voice coil motor of claim 1, comprising an adhe-
 sive material disposed between the cover can and the base,
 wherein the adhesive material is an insulating material.

8. The voice coil motor of claim 1, wherein the terminal
 is electrically separated from the cover can.

9. The voice coil motor of claim 1, wherein the first elastic
 member comprises first and second lower elastic members
 spaced apart from each other,

wherein the terminal comprises first and second terminals
 spaced apart from each other,

wherein the first lower elastic member electrically con-
 nects one end of the coil and the first terminal, and

wherein the second lower elastic member electrically
 connects an other end of the coil and the second
 terminal.

10. The voice coil motor of claim 1, wherein at least a part
 of a lower end of the first lateral plate of the cover can is
 disposed at a position lower than that of the first elastic
 member, and

wherein the first elastic member is spaced apart from the
 side-first lateral plate of the cover can.

11. A camera, comprising:

a circuit board;

an image sensor disposed on the circuit board;

the voice coil motor of claim 1 disposed on the circuit
 board; and

a lens coupled to the bobbin of the voice coil motor.

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12. A mobile phone, comprising the camera of claim 11.

13. A voice coil motor, comprising:

a base;

a cover can disposed on the base and having a first lateral
 plate;

a bobbin disposed in the cover can;

a coil disposed on the bobbin;

a magnet disposed between the coil and the cover can;

a first elastic member disposed between the bobbin and
 the base; and

a terminal electrically connected with the first elastic
 member,

wherein the terminal comprises a first area disposed in the
 cover can, a second area disposed on a lateral surface
 of the base, and a bent area disposed between first area
 and second area,

wherein at least part of the bent area is not overlapped
 with the first lateral plate of the cover can in a direction
 perpendicular to the optical axis, and

wherein the second area is not overlapped with the first
 lateral plate of the cover can in the direction perpen-
 dicular to the optical axis.

14. The voice coil motor of claim 13, wherein the base
 comprises a recess concavely formed on the lateral surface
 of the base, and

wherein the terminal is disposed on the recess of the base.

15. The voice coil motor of claim 13, wherein, in the
 direction perpendicular to the optical axis, one part of the
 bent area of the terminal is overlapped with the first lateral
 plate of the cover can and an other part of the bent area of
 the terminal is not overlapped with the first lateral plate of
 the cover can.

16. The voice coil motor of claim 13, wherein the bent
 area of the terminal comprises an area gradually away from
 the first lateral plate of the cover can.

17. The voice coil motor of claim 13, wherein, in the
 direction perpendicular to the optical axis, a distance
 between the first area of the terminal and an inner surface of
 the first lateral plate of the cover can is different from a
 distance between the second area of the terminal and an
 imaginary plane extending from the inner surface of the first
 lateral plate of the cover can.

18. The voice coil motor of claim 13, wherein the bent
 area of the terminal is from a bent point of the first area to
 a starting point of the second area disposed in a downward
 direction.

19. The voice coil motor of claim 13, comprising an
 adhesive material disposed between the cover can and the
 base,

wherein the adhesive material is an insulating material.

20. A camera device, comprising:

a base;

a cover can disposed on the base and having a first lateral
 plate, a second lateral plate, a third lateral plate, and a
 fourth lateral plate;

a bobbin disposed in the cover can;

a coil disposed on the bobbin;

a magnet disposed between the coil and the cover can;

a first elastic member disposed between the bobbin and
 the base;

a terminal electrically connected with the first elastic
 member; and

an adhesive material disposed between the cover can and
 the base,

wherein the cover can comprises a first corner between
 the first lateral plate and the second lateral plate, a
 second corner between the second lateral plate and the

third lateral plate, a third corner between the third lateral plate and the fourth lateral plate, and a fourth corner between the first lateral plate and the fourth lateral plate,
wherein the magnet comprises a first magnet part, a 5
second magnet part, a third magnet part, and a fourth magnet part disposed in the first to fourth corners, respectively,
wherein the terminal comprises a first area overlapped with the first lateral plate of the cover can, a second area 10 overlapped with a first later surface of the base in a direction perpendicular to an optical axis, and a bent area disposed between the first area and second area, wherein the second area is not overlapped with the first lateral plate of the cover can in the direction perpen- 15 dicular to the optical axis,
wherein a part of the adhesive material is disposed between the terminal and the first lateral plate of the cover can, and
wherein the adhesive material is an insulating material. 20

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